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APPENDIX

Nutri-RecQuest: a web-based search engine on current micronutrient recommendations

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Background: The EURRECA (EURopean micronutrient RECommendations Aligned) Network of Excellence collated current micronutrient recommendations. A user-friendly tool, Nutri-RecQuest, was developed to allow access to the collated data and to create a database source for use in other nutritional software tools.
Methods: Recommendations, that is, intakes of micronutrients sufficient to meet the requirements of the majority of healthy individuals of that population, from 37 European countries/organizations and eight key non-European countries/regions comprising 29 micronutrients were entered into a database. General information on the source of the recommendations, as well scientific background information, was added.
Results: A user-friendly web-based interface was developed to provide efficient search, comparison, display, print and export functions.
Conclusion: Easy access to existing recommendations through the web-based tool may be valuable for bodies responsible for setting recommendations, as well as for users of recommendations including scientists, policy makers, health professionals and industry. Adding related dietary reference values such as average nutrient requirements and upper limits may extend the utility of the tool.
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Keywords: micronutrients; recommendations; dietary reference intakes; database; web-based tool; EURRECA

Introduction

Most countries in Europe have established their own nutrient recommendations. As yet, there is no standard approach for deriving nutrient recommendations; they vary from country to country. The EURRECA (EURopean micronutrient RECommendations Aligned) Network of Excellence (http://www.eurreca.org) collated data on current micronutrient recommendations (Doets *et al.*, 2008a, b, de Wit *et al.*, 2009). Critically reviewing these recommendations revealed considerable variations between countries (Doets *et al.*, 2008a, b, 2009). Following the entry of recommendations in a database, a user-friendly software tool on current recommendations was developed for the following purposes:

(1) To allow easy access to the collated data on current recommendations with regard to micronutrients for all EURRECA partners and at a later stage to other stakeholders involved in setting recommendations.
(2) To develop a common database/data source to be used in other nutritional software tools (for example, for menu planning), which is developed in the context of EURRECA (Gurinović *et al.*, 2010).

This paper describes the newly developed web-based tool named Nutri-RecQuest to inform future potential users of its existence.

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Methods and results

Data

Information on current micronutrient recommendations was collated through questionnaires completed by national key informants involved in the development of recommendations, recommendation reports and scientific background reports (if available) at the end of 2007, and at the beginning of 2008. Details on data collation have been described elsewhere (Doets *et al*., 2008a, b, de Wit *et al*., 2009).

Recommended micronutrient intakes, that is, intakes sufficient to meet the requirements of the majority of healthy individuals (generally 97.5%) of a specific population or group, were available for 29 different micronutrients from 37 European countries, eight key non-European countries/regions (that is, United States/Canada, Australia/New Zealand, Japan, China, South Korea, South East Asia region, Brazil, Mexico), as well as recommendations set by the European Commission and the World Health Organization/Food and Agriculture Organization.

For each recommendation, the following basic data were entered into an excel sheet: region (that is, continent), country/organization, micronutrient, gender, population group, recommended amount (value or range or additional amount), special conditions (free text field containing assumptions regarding bioavailability, trimester pregnancy, activity level and so on), special condition group (fixed categories retrieved from free text field special condition) and remarks (additional information given by authors that do not fit into the above mentioned variables).

The following additional information was entered:

1. General information such as reference (author, title, year of publication and year of setting, weblink for reference), body responsible for setting of recommendations and source of origin (own report, shared report, adopted values).
2. Scientific background information: health indicators and type of evidence used for setting recommendations, and terminology/concept used for recommendation (that is, recommended daily allowance, which is defined as the estimated average nutrient requirement + 2*s.d. or adequate intake). As terminology varies between countries, the countries'/organizations' own terminology was included, as well as the standardized terminology proposed by King *et al*. (2007), that is, the proposal to use the term 'INLx' rather than 'recommended daily allowance' (Dhonukshe-Rutten *et al*., 2010).

Tool design

The tool consists of two parts:

1. an SQL database, including additional functionalities to assist data management by the tool administrator;
2. a web-based interface developed using Microsoft Visual Fox Pro.

Database. The database includes all data mentioned above, as well as additional data tables (for example, with conversion factors for different units used) to facilitate data management and working of the web-based tool. Macros and forms are included for editing 'current' data, inserting 'new' data (manual one by one or by importing a standardized excel file), deleting or archiving 'old' data, printing and exporting data, administration of additional data tables and downloading and uploading data to the web application.

The excel file with data collated on micronutrient recommendations was imported into the SQL database using a macro. During this process, lower- and higher-age limits were added to the database on the basis of the variable 'population group'.

See Figure 1 for an overview of the database structure.

Web-based interface. The web-based interface enables users to search and compare recommendations of different countries and/or different reports. The results can be displayed, printed or exported to excel sheets. The web interface will show only the most recent recommendations, although the database has the possibility to keep/archive 'old' recommendations.

Two 'search' options are offered in the tool. The simple search menu option enables the user to select one criterion from a dropdown list to refine the search. Optional criteria are region (for example, Europe, Asia and so on), country, body responsible for setting recommendations, year of publication, micronutrient, population group, gender and condition (for example, physical activity level, % bioavailability, trimester pregnancy and so on). Within each criterion, multiple advanced selections are possible, for example, the selection of two countries. Such advanced search allows to select from the large number of criteria available and combine several criteria at the same time. Additional criteria are author, title, year of publication of the reference and age (lower limit, upper limit). Figure 2a shows all the web pages displayed when carrying out an advanced search, whereas Figure 2b shows only a screen print of the data and buttons that are displayed after making an advanced search selection. By using the buttons 'more' and 'details' (see Figure 2b), the available, general information on the source, scientific background information and remarks applying to the recommendation of interest can all be displayed.

The 'compare' function of the tool enables users to list micronutrient recommendations of all included countries or references (the latter will result in fewer records, as some countries have directly adopted recommendations of other countries/organizations. Moreover, some countries jointly set recommendations) for one micronutrient and gender for various specific ages at one time, that is, for 9 months, 5, 15, 25, 50 and 70 years and so on. Another possibility is to compare recommendations for pregnant or lactating women

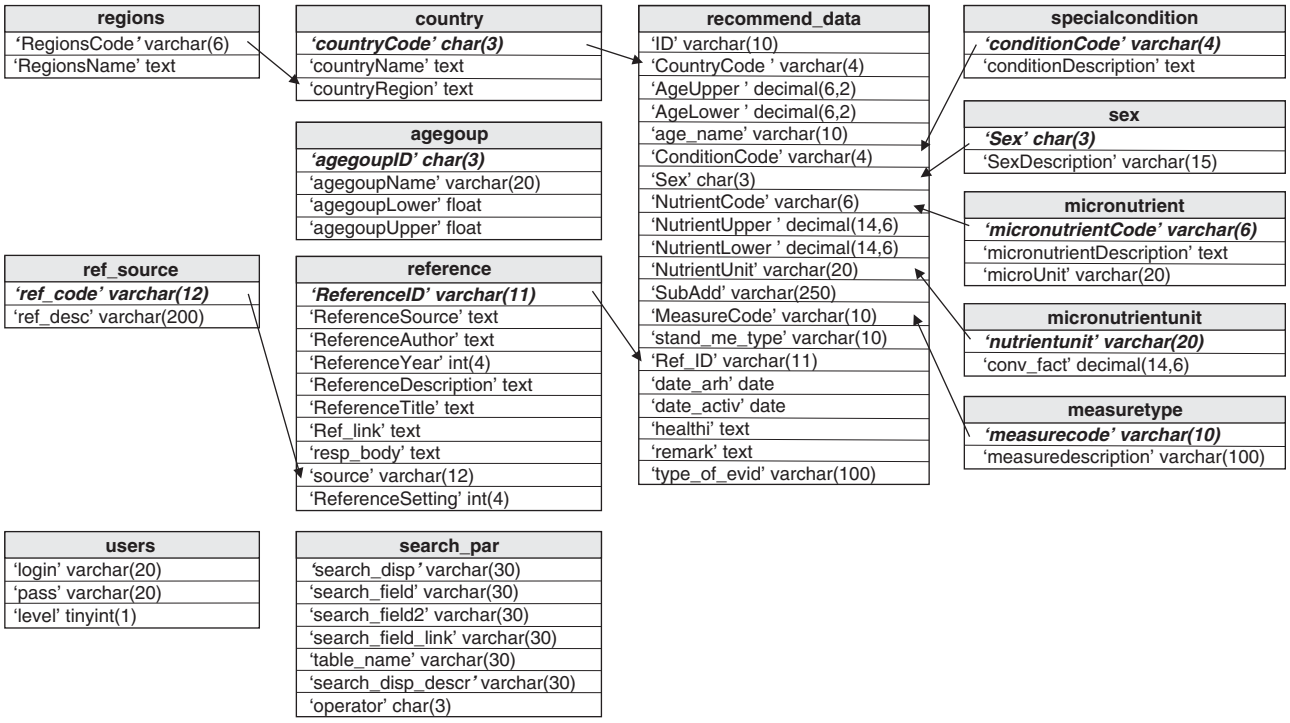


Figure 1 An overview of the database structure.

between countries and references. Specific ages need to be chosen as the age categories may vary between references.

As micronutrient recommendations usually consist of values, ranges, multiple values applying to one population group (for example, values for different activity levels), or additional amounts for subgroups (for example, pregnant women), standardization procedures were defined to enable a comparison of the recommendations. In cases in which multiple recommendations were given for one population group, for example, when different physical activity levels were used, the mean of all given values was used. In cases in which a range was given, the mid value was used.

For pregnant and lactating women, recommendations were sometimes defined as additional amounts only. To make comparison possible in these circumstances, the additional amount was added to the recommendation set for women aged 26 years. If recommendations were not given in the most common unit, values were converted into that unit. However, in some cases, this was not possible, for instance, when recommendations were expressed as amount per 1000 kcal or amount per gram of poly unsaturated fatty acids. In cases in which values were based on calculations, they were rounded off to two decimal points.

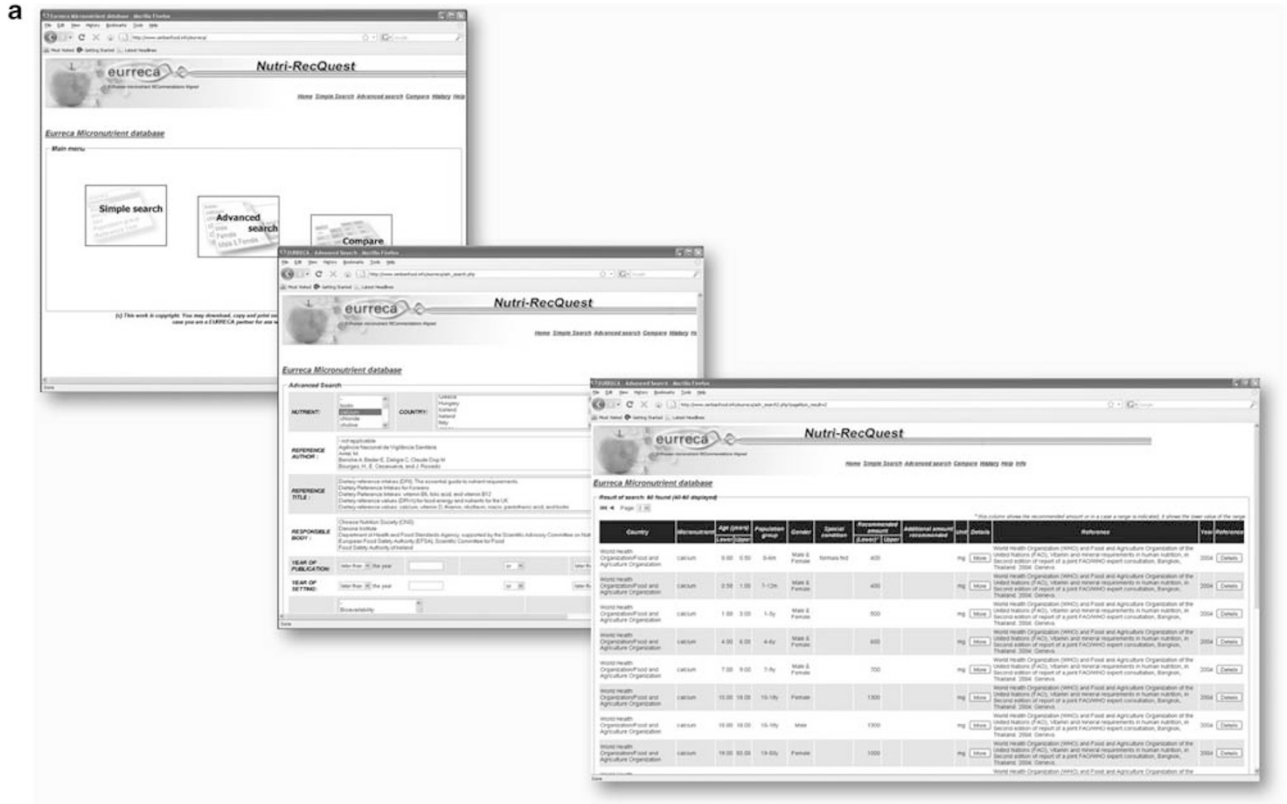
Discussion

Currently, the end-user web interface is accessible through the EURRECA website for EURRECA partners, as well as for organizations working closely together with EURRECA, such as the European Food Safety Authority. In addition, the SQL database will be used as the key source of data for nutritional software for diet planning, targeting health professions that have also been developed in the context of EURRECA (Gurinović *et al*., 2010).

The database is developed in such a way that revisions of current recommendations can be included by the administrators of the tool (Division of Human Nutrition of Wageningen University, Institute of Medical Research, Department of Nutrition and metabolism, University of Belgrade) using a macro and a standard excel file for entry. Outdated recommendations can be archived and made available by the administrator on request.

When 'new' recommendations are set by European countries/organizations or key non-European countries/organizations through the coming 'EURRECA' years, these will be added. Furthermore, the EURRECA Network is currently exploring the possibilities of maintaining and optimizing the tool, and updating the data on a cost neutral base after 2011.

The comprehensive data stored in this tool offer a number of opportunities for its potential use. Stakeholders involved in the process of setting recommendations or users of these dietary reference values such as scientists, nutrition policy makers, nutrition societies, consumer groups, small and medium enterprises (nutritional consultancies and ingredient/food producers) and the larger food industry may profit from this tool. In the private sector, for instance, retrieving



Country	Micronutrient	Age (years) Lower	Age (years) Upper	Population group	Gender	Special condition	Recommended amount (Lower)*	Recommended amount Upper	Additional amount recommended	Unit	Details	Reference	Year	Reference
World Health Organization/Food and Agriculture Organization	calcium	0.00	0.50	0-6m	Male & Female	formula fed	400			mg	More	World Health Organization (WHO) and Food and Agriculture Organization of the United Nations (FAO). Vitamin and mineral requirements in human nutrition, in Second edition of report of a joint FAO/WHO expert consultation, Bangkok, Thailand. 2004: Geneva.	2004	Details
World Health Organization/Food and Agriculture Organization	calcium	0.58	1.00	7-12m	Male & Female		400			mg	More	World Health Organization (WHO) and Food and Agriculture Organization of the United Nations (FAO). Vitamin and mineral requirements in human nutrition, in Second edition of report of a joint FAO/WHO expert consultation, Bangkok, Thailand. 2004: Geneva.	2004	Details
World Health Organization/Food and Agriculture Organization	calcium	1.00	3.00	1-3y	Male & Female		500			mg	More	World Health Organization (WHO) and Food and Agriculture Organization of the United Nations (FAO). Vitamin and mineral requirements in human nutrition, in Second edition of report of a joint FAO/WHO expert consultation, Bangkok, Thailand. 2004: Geneva.	2004	Details
World Health Organization/Food and Agriculture Organization	calcium	4.00	6.00	4-6y	Male & Female		600			mg	More	World Health Organization (WHO) and Food and Agriculture Organization of the United Nations (FAO). Vitamin and mineral requirements in human nutrition, in Second edition of report of a joint FAO/WHO expert consultation, Bangkok, Thailand. 2004: Geneva.	2004	Details
World Health Organization/Food and Agriculture Organization	calcium	7.00	9.00	7-9y	Male & Female		700			mg	More	World Health Organization (WHO) and Food and Agriculture Organization of the United Nations (FAO). Vitamin and mineral requirements in human nutrition, in Second edition of report of a joint FAO/WHO expert consultation, Bangkok, Thailand. 2004: Geneva.	2004	Details
World Health Organization/Food and Agriculture Organization	calcium	10.00	18.00	10-18y	Female		1300			mg	More	World Health Organization (WHO) and Food and Agriculture Organization of the United Nations (FAO). Vitamin and mineral requirements in human nutrition, in Second edition of report of a joint FAO/WHO expert consultation, Bangkok, Thailand. 2004: Geneva.	2004	Details
World Health Organization/Food and Agriculture Organization	calcium	10.00	18.00	10-18y	Male		1300			mg	More	World Health Organization (WHO) and Food and Agriculture Organization of the United Nations (FAO). Vitamin and mineral requirements in human nutrition, in Second edition of report of a joint FAO/WHO expert consultation, Bangkok, Thailand. 2004: Geneva.	2004	Details
World Health Organization/Food and Agriculture Organization	calcium	19.00	50.00	19-50y	Female		1000			mg	More	World Health Organization (WHO) and Food and Agriculture Organization of the United Nations (FAO). Vitamin and mineral requirements in human nutrition, in Second edition of report of a joint FAO/WHO expert consultation, Bangkok, Thailand. 2004: Geneva.	2004	Details

Figure 2 (**a**) Screen print of the web pages displayed after making an advanced search selection. (**b**) Screen print of the detailed data displayed after making an advanced search selection.

recommendations of export markets is not straightforward, even if they may be needed to formulate or label food products. Potentially, NutriRec-Quest may be used to design foods that meet recommendations of different countries (users should be cautioned that the legal standing of recommendations may vary from mandatory regulations to mere advice to the public).

Adding macronutrients or other dietary reference values, such as average nutrient requirements and upper limits may optimize its utility. Adding average nutrient requirements, for example, would make it possible to extend the use of the database to the assessment of inadequacy of micronutrient intake.

Conclusion

Access to this web-based tool and the comprehensive data it contains on micronutrient recommendations across Europe and key non-European countries and organizations may be valuable for bodies responsible for and persons involved in setting recommendations, as well as for users of recommendations including scientists, policy makers, health professionals and industry. Adding other macronutrients or other dietary reference values, such as average nutrient requirements and upper limits, may extend its utility.

Conflict of interest

L Bucchini has received consulting fees and has equity/stock ownership in Hylobates Consulting, and has received grant support from EURRECA and an EC funded grant. He has also consulted for small/medium companies in the food supplement sector. The remaining authors have declared no financial interests.

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